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ABSTRACT

A study was conducted to examine the reading levels of United States Air Force civilian employees according to occupational groupings and grade structure. Approximately 1,050 Air Force civilian subjects were tested on the Nelson-Denny Reading Test or the California Reading Test. Subjects were selected from eight Air Force bases representing the major commands. The findings demonstrated that the reading grade level and the grade classification of subjects were associated. However, many difficulties are associated with the application and interpretation of the reading grade level concept as it relates to occupational level. (Author/MKM)

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AIR FORCE HUMAN RESOURCES LABORATORY

READING GRADE LEVELS OF AIR FORCE CIVILIAN PERSONNEL

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This interim report was submitted by the Manpower and Personnel Division, under Project 7719, with HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235. Capt Randy H. Massey (MPAM) was the Principal Investigator for the Laboratory.

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

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The objective of this study was to examine the reading levels of Air Force civilians according to occupational groupings and grade structure. Civilian grade structure was compossed of classification types General Schedule (GS), Wage Supervisor (WS), and Wage Grade (WG) and grade levels (1, 2, 3, . . .). Approximately 1,050 Air Force civilian subjects were tested on the Nelson-Denny Reading Test (ND) or the California Reading Test (CR). The ND was administered to GS-7 and above and WS subjects. The CR was administered to GS-1 through GS-6 and to Wage Grade (WG) subjects because of the expected lower reading level of these groups. Subjects were selected from eight Air Force bases representing the major commands. The GS, WG, and WS samples were selected to be proportionate to the composition of the Air Force civilian population.

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Reading grade levels were reported for Air Force civilians according to occupational groupings and grade structure. This study demonstrated that the RGL of subjects was associated with the grade of subjects; however, the meaning of this association is not clear. Difficulties associated with the application and interpretation of the RGL concept were discussed. It was concluded that other RGL questions or associated variables need to be investigated to determine where the utility of RGL knowledge lies—in selection, in classification, revision of certain materials, or in decisions about the extent of remedial training and to whom it should be administered.

PREFACE

This research was conducted under Project 7719, Air Force Development of Selection, Assignment, Performance Evaluation, Retention and Utilization Devices; Task 771912, Air Force Selection and Classification Programs. Work unit 77191225 was established in responses to Requirement for Personnel Research (RPR 76-25) submitted by the Air Force Manpower and Personnel Center (AFMPC/MPCYP).

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READING GRADE LEVELS OF AIR FORCE CIVILIAN PERSONNEL

I. INTRODUCTION

The preponderance of past and present research by military agencies on Reading Grade Level (RGL) (Duffy & Nugent, 1978; Hooke, DeLeo, & Slaughter, 1979; Kniffin, Stevenson, Klare, Entin, Slaughter, & Hooke, 1979; Mathews, Valentine, & Sellman, 1978; Mockovak, 1974; Sticht, 1975) has been restricted to the study of military subjects, and has primarily focused on selection, classification, and training of military personnel only. Research has shown that there is a gap between the reading requirement level and the average estimated reading ability of military personnel in many career fields (Duffy & Nugent, 1978; Mockovak, 1974). One approach to rectify this problem is to simplify written materials so that they are easier to use (Hoehn & Lumsdaine, 1958). Another approach is to improve individuals reading skills to those required on the job (Huff, Sticht, Joyner, Groff, & Burkett, 1977; Jealous, Bialek, Pitpit, & Gordon, 1975; McGaff & Harding, 1974; Sticht, 1975). The first approach is more cost effective and easier to implement, so a program has been initiated by the Directorate of Administration to make Air Force publications more comprehensible.

A first step in determining how comprehensible Air Force publications are to the people who must read them is to determine the RGL of the target population. Although RGL research is available on military personnel, no formal research has been conducted or reported for Air Force civilian employees. Prior military research has investigated reading levels according to specific occupational groupings (Duffy & Nugent, 1978; Mockovak, 1974). The purpose of this study was to examine the reading levels of Air Force civilians according to occupational groupings and grade structure. Civilian grade structure is composed of classification types General Schedule (GS), Wage Supervisor (WS), and Wage Grade (WG) and grade levels (1, 2, 3, . . .). This approach should provide useful information and perspectives in examining reading levels of civilian personnel so that a better match might be made between the RGL of employees and the RGL that is required to understand Air Force publications.

II. METHOD

Subjects

Approximately 1,050 Department of Air Force civilian subjects were tested on the Nelson-Denny Reading Test (ND) or the California Reading Test (CR). The ND was administered to GS-7 and above and to WS subjects, and the CR was administered to GS-1 through GS-6 and to WG subjects because of the expected lower reading level of these groups. Subjects were selected from eight Air Force bases representing the major commands (see Appendix A). Appendix B gives a more detailed description of the characteristics of the samples. The GS, WG, and WS samples were selected to be proportionate to the composition of the Air Force civilian population. Except for Pentagon examinees, one-half the CR sample of examinees was GS and one-half was WG. All Pentagon examinees were GS. In the ND sample, about 80% were GS and 20% WS, again except at the Pentagon where all were GS. Each test administration was accomplished in two to four sessions, depending on facilities available at each base. Because participation was voluntary, fewer examinees were tested than were scheduled.

Tests

The reading tests employed in this study were the Nelson-Denny Reading Test Form C (Brown, 1976) and the reading subtest of the California Achievement Test (Tiegs & Clark, 1970). The Nelson-Denny Form C has an RGL range from academic grades 6 to 15 and is primarily targeted at about academic grades 11 to 13. The California Reading test is primarily targeted at about academic grades 9 to 11. Both tests contain vocabulary and reading comprehension subtests which were scored separately according to the published test norms.

Data Analysis

The published test norms were used to convert raw scores to RGL scores. General distributional statistics, including score means, medians, and standard deviations, were calculated for the civilian grade and occupational groupings. Due to small sample size in the original groupings, larger groupings were obtained by collapsing some of the smaller groups. To determine differences among the CR and ND sample RGL means for the various grade and occupational groupings, *t* tests for independent samples were used. It was hypothesized that a significant positive civilian grade-RGL relationship and a positive RGL occupational complexity relationship would be found (i.e., the higher the grade or occupational difficulty level, the higher would be the RGL).

III. DISCUSSION

Table 1 shows the RGL results by grade groupings for the CR sample. The mean RGL for GS-1 to GS-3 was 11.56 and for GS-4 GS-6 was 12.47; the mean difference was significant ($p < .0005$). The mean RGL for WG-1 to WG-4 was 8.88, for WG-5 to WG-8 was 9.51, WG-9 to WG-10 was 11.25, and for WG-11 and above was 12.26. The differences among means for the WG groupings were significant with the exception of the WG-1 to WG-4 versus the WG-5 to WG-8 comparison. The overall mean RGL was 12.25 for GS-1 to GS-6 personnel , and 10.59 for all WG personnel in the CR sample (see Table 2). A *t* value of 8.40 ($p < .0005$) was obtained for the comparison between GS and WG personnel.

Table 1. Reading Grade Level by Civilian Grade
(California Reading Test Sample)

Grade	N	Mean RGL	SD RGL	t Value
GS-1 to GS-3	85	11.56	2.11	3.97**
GS-4 to GS-6	271	12.47	1.77	
WG-1 to WG-4	13	8.88	3.25	
		.64		
WG-5 to WG8	99	9.51	3.28	
				4.34**
WG-9 to WG-10	111	11.25	2.51	
				2.17*
WG-11 and above	34	12.26	1.91	

*Significant at .05.
**Significant at .0005.

Table 2. Reading Grade Level Comparison for GS and WG Personnel (California Reading Test Sample)

	GS-1 to GS-6	All WG Grades
Total N	356	257
Median RGL	13.9	11.0
Mean RGL	12.25	10.59
SD RGL	1.89	2.99
	t =8.40*	

*Significant at .0005.

Table 3 shows the RGL results by grade for the ND sample. The mean RGL for GS-7 to GS-11 was 14.02, and for GS-12 and above was 14.65; the two means were significantly different ($p < .0005$ level). The mean RGL for WS-1 to WS-8 was 10.55 and for WS-9 and above personnel was 11.63. The obtained *t* value of 1.31 between these two RGL means was not significant. The overall mean RGL for GS-7 and above personnel was 14.22, and the mean RGL for all WS personnel in the ND sample was 11.13 (see Table 4). A *t* value of 11.69 ($p < .0005$ level) was obtained for the comparison of GS and WS personnel.

Table 3. Reading Grade Level by Civilian Grade (Nelson-Denny Reading Test Sample)

Grade	N	Mean RGL	SD RGL	t Value
GS-7 to GS-11	191	14.02	1.56	3.58*
GS-12 and Above	90	14.65	.85	
WS-1 to WS-8	22	10.55	2.61	1.31
WS-9 and Above	26	11.63	3.05	

*Significant at .0005.

Table 4. Reading Grade Level Comparison for GS and WS Personnel (Nelson-Denny Reading Test Sample)

	GS-7 to GS-13	All WS Grades
Total N	281	48
Median RGL	15.2	11.1
Mean RGL	14.22	11.13
SD RGL	1.40	2.88
	t =11.69*	

*Significant at .0005.

Some pertinent RGL similarities are indicated in both the CR and the ND samples, e.g., the higher the grade level grouping, the higher the reading level (see Tables 1 and 3). The mean RGL for GS-4 to GS-6 was significantly higher than for the GS-1 to GS-3 personnel in the CR sample, and the mean RGL for GS-12 and above was significantly higher than for the GS-7 to GS-11 personnel in the ND sample. This increasing RGL-grade relationship was indicated for all grade level groupings for GS, WG, and the WS personnel in both the ND and CR samples, although not all of these grade groupings differed significantly. Another ND-CR similarity is the significantly higher reading levels of GS personnel over the WG and WS personnel. In the CR sample, GS-1 to GS-6 personnel possessed a significantly higher reading level than did the WG personnel. In the ND sample, GS-7 and above personnel also possessed a significantly higher reading level than did the WS personnel. However, when examining the median RGLs of the ND and CR samples, the WS personnel median RGL of 11.1 was similar to the WG median reading level of 11.0. The GS-1 to GS-6 personnel (median RGL =13.9) and the GS-7 and above personnel (median RGL =15.2) median reading levels were higher than either the WG or the WS personnel. In essence, the WS personnel reading levels are much closer to those of WG personnel than to those of GS personnel in the ND and the CR samples.

One implication for making Air Force publications more comprehensible to civilian personnel includes targeting the reading level of manuals and other written material to the reading level of the intended audience. For example, written materials for GS personnel may not be appropriate for WG personnel. Another implication is that manuals or other written material should be targeted at the lowest grade level grouping that will receive such materials. Materials written for higher GS personnel at their respective reading level, particularly GS-12 and above, will engender communication difficulties if used or transmitted without modification to the lower GS organizational levels. The same can also be said of communications between the WS or higher WG personnel and the lower WG personnel.

From a statistical viewpoint, in order to insure communication with at least 84% of the GS-1 to GS-3 personnel group (to include everyone from -1 Statistical deviation (SD) and above), a reading materials RGL no higher than 9.45 is required. If 93% group communication is desired (-1.5 SD and above), an RGL of about 8.4 is required. Since miscommunication is economically costly, it is recommended that reading target levels for written materials be set lower than the average reading level of the expected audience so as to insure maximum communication.

A comparison of the ND and CR samples reveals that the mean age of the CR sample was 40.4 and of the ND sample was 47.0. In fact, only about 2% of the entire sample was 22 or younger. Additionally, the mean education for the CR sample was 12.29 and the ND sample was 14.13. These mean ages and education levels tend to suggest an older generation which has likely been with Federal Civil Service for many years. In essence, these data probably do not reflect those currently entering the Air Force work force. If it is believed that the general population has suffered a decline in reading skills (Harnischfeger & Wiley, 1975) and/or if selection policies have become less restrictive, then the RGLs presented here should be considered tentative, or at best, as high RGL estimates for making policy decisions regarding the present or future AF civilian work force. The data suggest the desirability of preparing governmental reading materials with the lowest possible RGL (difficulty level), so that the danger of miscommunication is reduced. The only other known alternatives are to offer remedial reading training to employees after they are hired, or to refuse to hire those whose reading level is below the RGL of the material they are to read. The first of these alternatives could be costly and the second alternative would restrict the applicant pool so severely that filling job openings could become a serious problem.

Tables 5 and 6 show the WG and GS RGL results by general occupational groupings for the CR sample. The WG occupational groupings (Table 5) were obtained from the Dictionary of Occupational Titles (DOT), developed by the U.S. Department of Labor (1965). The DOT is probably the most comprehensive and widely accepted compendium of occupational information. The GS occupations were grouped according to the GS Position Classification Plan for government employees (Table 6).

Table 5. Reading Grade Level by WG Occupational Grouping (California Reading Test Sample)

Occupational Grouping	N	Occupational Complexity Ranking	Mean RGL	SD RGL	t ratios Comparisons
Miscellaneous Occupations	70	1	9.59	3.28	.81
Service Occupations	17	2	10.29	2.49	.59
Structural Occupations	66	3	10.72	2.73	1.22
Machine Trade Occupations	78	4	11.28	2.77	1.29
Bench Work Occupations	25	5	12.07	2.29	

Table 6. Reading Grade Level by GS Occupational Grouping (California Reading Test Sample)

	Occupational Grouping	N	Mean RGL	SD RGL
1	Supply (GS 2000)*	43	11.88	2.03
2	Business and Industry Group (GS 1100)*	22	11.95	2.02
3	Transportation (GS 2100)*	10	12.03	2.25
4	General Administrative Clerical, and Office Service Group (GS 300)*	155	12.11	2.04
5	Personnel Management and Industrial Relations Group (GS 200)*	32	12.63	1.40
6	Mathematics and Computer Science Group (GS 1500 and GS 330-335)*	15	12.63	1.83
7	Accounting and Budget Group (GS 500)*	39	12.67	1.61
8	Miscellaneous	36	12.35	1.77

*Civil Service Occupational Series.

In the CR sample of WG occupational groupings, the mean RGL ranged from a low of 9.59 for Miscellaneous Occupations to a high of 12.07 for Bench Work Occupations (see Table 5). An occupational complexity level ranking was assigned by the author, considering the task, training, and mental requirements needed by the occupations included within each of the five WG occupational cluster groupings (see Appendix C). For example, most of the jobs in Miscellaneous Occupations require primarily physical work, minimum training, little mental effort, and noncomplex task performance. In contrast, Bench Work Occupations require little physical work, extensive specific training, and a high degree of mental effort and task complexity (troubleshooting and repairing sophisticated electrical and mechanical components). The Service Occupations, Structural Occupations, and Machine Trade Occupations also seem to vary in overall occupational complexity as indicated in Table 5. When the occupational groupings are ranked by "complexity" of job, the RGLs show a perfect rank order relationship. The highest RGL is associated with the most "complex" group, the lowest with the least "complex" group, and so on among the groups (see Table 5).

Table 6 shows the RGL data by occupational groupings for GS personnel in the CR sample. The RGL means ranged from a low of 11.88 for the Supply grouping to a high of 12.67 for the Accounting and Budget group. The CR sample analysis by occupational grouping indicated more RGL differences in the WG groupings than in the GS groupings. This is probably due to the wider diversity of ability, training, and task requirements required for WG occupations. For example, the range of RGL means in the CR sample for all WG occupations was 9.59 to 12.07, whereas the range for all GS occupations was 11.88 to 12.35. RGL standard deviations were also consistently higher in the WG groups.

IV. RESULTS

The main findings of this study were as follows:

1. The GS-1 to GS-6 personnel possessed a significantly higher RGL than did the WG personnel in the CR sample (12.25 vs. 10.59).

2. The GS-7 to GS-11 personnel obtained significantly higher RGL scores than did the WS personnel in the ND sample (14.22 vs. 11.13).

3. The median RGL for WS personnel of 11.1 was more similar to the WG median RGL (11.0) than to the GS personnel in the CR sample (13.9) or in the ND sample (15.2).

4. The reading level of manuals and other written materials should be set lower than the RGL of the expected audience to insure maximum communication.

V. CONCLUSIONS

Deciding what should be the RGL of material that must be read by workers of a given grade in a given job is not an easy decision. In the first place, if material to be read is written at, say, a 9.0 RGL and if a measurement indicates that the average RGL of the people who will be required to read that material is 9.0, it is tempting to say that the reading material matches the reader and that there is no communication problem. However, an average RGL of 9.0 in the mesured population *by definition*, means that half the group would be below that average and should therefore have some trouble handling the material. It follows, then, that if the attempted solution involves the rewriting, on a less difficult level, of the material to be read, a decision must be made concerning how far down the RGL should be moved. The solution to this problem is complex and requires information not currently available, for example, answers to the following questions.

1. Is there some lower limit to how much RGL can be reduced in a given document without increasing the length of the material intolerably? Worded another way, is there some point of diminishing returns in the effort to reduce the RGL?

2. What proportion of reading material must be read by various grades (and across various occupations)? To the extent that the reading material is common across groups, to that extent is it desirable to lower the RGL to the lowest practical level for *all* users of the material, regardless of the grade of the prospective readers?

3. In an exercise to reduce RGL from, say, 9.0 to 8.0, would it be significantly more difficult to lower it to 7.0? Or 6.0? If it is not more difficult, there is even less reason to try to match RGLs across subjects and materials. If it is more difficulty, then decisions concerning the reduction of RGL of materials should be based on cost-effectiveness considerations.

Because of the above reasoning, the findings of this study (namely, that there are significant relationships between the classification grade of subjects and their RGL) have little immediate operational impact. This knowledge might be used in the future, in conjunction with the missing information listed above, to determine the priority of allocation of limited resources. Rewriting of required materials might be done first in those areas which show the largest discrepancies between RGL of subjects and RGL of materials (after they are known). Even this application is somewhat weak because of the possibility that the RGL of the subjects is almost certainly associated with general mental ability of the subjects and that general mental ability is associated with promotion on the job. General mental ability may have been the primary determinor of advancement on the job, and it may be an unrelated circumstance that reading ability, because of its correlation with general mental ability, happened to advance also.

This is a far different matter from interpreting these findings to mean that the differences in RGL of subjects by classification grade implies any direct or necessary requirement for higher or lower difficulty level of materials which must be read at the various levels.

This study demonstrates that the RGL of subjects is associated with the classification grade of the subjects. It remains for further research to indicate where the utility of this knowledge lies—in selection, in revision of certain materials, in decisions about the extent of remedial training and to whom it should be administered, or in some related activity.

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APPENDIX A: AIR FORCE BASES, PARTICIPATING IN SURVEY

Location	Air Force Command	N
Pentagon	Air Force Headquarters	85
Lackland AFB	Air Training Command	101
Randolph AFB	Air Training Command	103
Kelly AFB	Logistics Command	179
McClellan AFB	Logistics Command	189
Andrews AFB	Military Airlift Command	124
Carswell AFB	Strategic Air Command	57
Edwards AFB	Systems Command	157
Bergstrom AFB	Tactical Air Command	50
Unclassified		5
		1,050

APPENDIX B: SAMPLE CHARACTERISTICS
(Total N =1,050)

Sex		Civilian Category	
Male	= 59%	GS	= 66%
Female	= 40%	WG	= 26%
	1% *	WS	= 6%
	100%		2% *
			100%

Race		Test Taken	
White	= 68%	California Reading	= 65%
Spanish American	= 18%	Nelson-Denny Ready	= 34%
Black	= 9%		1% *
American Indian	= 1%		100%
Oriental	= 1%		
Other	= 2%		
	1% *		
	100%		

*Invalid or nonapplicable responses.

APPENDIX C: LIST OF WAGE GRADE OCCUPATIONS IN SURVEYS

1. Miscellaneous Occupations

Boiler Plant Operation
Brakeman and Conductor
Engineering Equipment Operator
Equipment Operator
Forklift Operator
Laborer
Packer
Materials Expeditor
Rigger
Sandblaster
Tools and Parts Attendant
Warehouseman

2. Service Occupations

Baker
Cook
Food Service Worker
Laundry Worker
Meat Cutter
Pest Controller
Presser
Janitor
Storeworker

3. Structural Occupations

Asphalt Worker
Blocker and Bracer
Carpenter
Cement Finisher
Crane Operator
Electrician
Painter
Plumber
Sheet Metal Mechanic
Welder
Wood Worker

4. Machine Trade Occupations

Air Conditioning Mechanic
Aircraft Mechanic
Automotive Mechanic
DI Sinker
Machinist
Maintenance Mechanic
Medical Equipment Repairer
Toolmaker
Utility System Repairer

5. Bench Work Occupations

Electronic Integrated Systems
Electronic Mechanic
Instrument Mechanic
Instrument Maker
Optical Instrument Repairer
Electrical Equipment Repairer

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